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EVALUATING TEACHER FUNCTIONS.

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A CRUCIAL ASPECT OF TEACHER ACTIVITY UNDER INDIVIDUALLY PRESCRIBED INSTRUCTION (IPI) IN MATHEMATICS IS THE DEVELOPMENT OF INDIVIDUALIZED LESSON PLANS OR PRESCRIPTIONS. THE QUALITY OF THESE PRESCRIPTIONS IS A MAJOR DETERMINANT OF THE EXTENT TO WHICH INSTRUCTION IS ACTUALLY INDIVIDUALIZED AND THE EXTENT TO WHICH EACH PUPIL IS PERMITTED TO PROGRESS AT HIS OWN BEST PACE. THE EVALUATION OF TEACHER PERFORMANCE BASED ON A MODEL OF PRESCRIPTION WRITING SHOWS THAT INDIVIDUAL PRESCRIPTIONS VARY AMONG CHILDREN, THAT EACH TEACHER HAS DEVELOPED A PERSONAL STYLE, AND THAT MOST TEACHERS RELY ALMOST EXCLUSIVELY ON PRE-UNIT TESTS. THE RESULTS OF THE STUDY SHOW THAT IMPROVEMENT OF IPI REQUIRES TEACHERS TO HAVE (1) CURRENT, EASILY AVAILABLE, AND COMPREHENSIVE INFORMATION ABOUT EACH STUDENT, (2) A GREATER VARIETY OF ASSIGNABLE MATERIALS, (3) SPECIFIC DEFINITIONS OF THE TERMS "MASTERY" AND "SELF-DIRECTION" IN RELATION TO OPERATING PROCEDURES, AND (4) A RATIONALE BEHIND VARIATIONS IN PRESCRIPTIONS WHICH CLOSELY FOLLOWS EACH CHILD'S LEARNING NEEDS. A RELATED DOCUMENT IS ED 010 210. THIS PAPER WAS PRESENTED AT THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION MEETINGS (WASHINGTON, D.C., FEBRUARY 16-18, 1967). (TT)

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EVALUATING TEACHER FUNCTIONS

John O. Bolvin

Evaluating the teachers' functions in Individually Prescribed Instruction involves an assessment of the program in operation. What are the functions of teachers in this program and how do teachers carry out these functions? Thus far, our study here has been concerned with studying teacher functions and practices with the goal of improving them. What I shall discuss here involves only one aspect of this problem, that of prescription writing.

A crucial aspect of teacher activity under IPI is the development of individualized lesson plans or prescriptions. Each day, the teachers in the IPI system must evaluate each student's progress and determine what the student should do next. This involves diagnosing by subject area what each child in her class can already do and what he is ready to do next to proceed through the math curriculum at his own rate with materials and instruction suited to him. In practice this means that the teacher must write an individual lesson plan or prescription for each child each day. The quality of these prescriptions is a major determiner of the extent to which instruction is actually individualized and of the extent to which each pupil is permitted to progress at his own best pace.

Fortunately this is one aspect of teacher activity that leaves a record and therefore can be studied quite intensively.

Attention was called to the prescription writing process by some of the other evaluation data that have been gathered and reported in the past. Part of this was a concern that the differences among pupils in rate of progress were not always as great as one would feel they might be. Also involved was the finding that there seemed to be little correlation between intelligence and rate of progress or between rate of progress in one subject and rate of progress in another.

These results suggested an investigation of some of the factors affecting rate, and an obvious factor to investigate was the nature of the prescriptions. Are prescriptions really individualized or is there a tendency for teachers to make all of them very much alike? If they are all very much alike, could teacher prescription-writing-behavior be changed to produce greater individualization? And if prescriptions became more tailored to the abilities of the individual, would this lead to greater variability in rate of progress? In a sense, this is a problem of examining some of the specific contingencies between the nature of prescriptions and the rate of pupil progress.

A first step in investigating this area was to make a careful analysis of actual prescriptions. During the early stages of development of IPI, the teachers and Center staff worked out a model of prescription writing based upon theory and practices. This model included the following aspects:

1. Assigning a pre-unit test covering the set of objectives that the student is ready to begin working in. (See Table I)

2. From the results of the pretest, the teacher is to select the first objective for which the student's score indicates lack of mastery.

3. Having selected the objective, the teacher is ready to prescribe the appropriate materials and techniques of instruction based upon:

    a. The maturity of the student

    b. The student's entering knowledge of the objective

    c. His overall subject ability

    d. The type of learner that he seems to be and

    e. The student's ability to be self-directed

4. As the student begins working, his prescriptions should provide the experiences and practice necessary to help him achieve mastery of the assigned objective.

5. Once performance indicates mastery of the objective, he is again pretested over the next objective for which he had lack of mastery.

6. Finally, after repeating this procedure for all of the objectives necessary in a given unit, the student is posttested over all the objectives within that unit.

If this then is the procedure, the question arises as to how well are the teachers able to follow it? This was a question of major concern in our evaluation of teacher performance. To study this, a systematic study was made of the prescriptions written during the second year of IPI. This analysis led to three major findings:

1. Over an entire unit of study, individual prescriptions vary from child to child.

2. Each teacher seemed to develop his or her own style of prescription writing and

3. Most teachers seemed to rely almost completely upon the pre-unit test as the basis for prescription writing.

In examining the prescriptions for all students, regardless of age, grade or teacher who worked in a given unit in mathematics, we have not found even two students who were given exactly the same materials. Table II reports for selected units the percent of agreement of prescriptions by objective within the units as well as for the entire unit.

To generalize about the teacher style of prescription writing, there are two extremes that can serve as illustrations:

Teacher 1 - This teacher follows the recommended procedure to the point of actually assigning materials. At this point, she will generally start all students with materials that introduce the objective and continue assigning materials until the child has nearly exhausted the materials available. When questioned about this technique, she offers the following reasons: (1) Mastery is more than a score on a test and involves practice, (2) Students seem to enjoy doing tasks they can handle and (3) If we want to develop self-directed learners, we have to provide the student with "easy" materials that he can handle before giving him more "challenging" materials. Therefore, most of her prescriptions show pretest - lots of materials - posttest.

> Teacher 2 - Teacher 2 has a style that is almost entirely opposite of Teacher 1. His style also begins at the assignment of materials stage but he tries to select very few tasks for each objective in the unit and then assigns a posttest. Generally, the students fail to reach the mastery criterion on this first posttest so he assigns a few more tasks and another posttest. This procedure is followed until the student finally indicates mastery. His style, over simplified, goes pretest - little materials - posttest - material - posttest, etc.

Between these two extremes there are many variations.

As for the third finding, that of the almost exclusive reliance upon the pretest, this appeared when we examined just the first prescription assigned to a student for each of the skills or objectives of certain selected units. This examination revealed that these initial prescriptions were very nearly the same for all students regardless of age, I.Q., type of learner, etc. That is, teachers were not actually individualizing prescriptions on the basis of the wealth of information that they actually have but seemed to be using only the pretest information.

In a special study to investigate this, twenty previously written prescriptions were selected at random from the hundreds of prescriptions on file. The teachers were provided with the pretest information for each sample prescription (as shown by example in Table III) and the student learning materials (this is the student work pages) available to the teacher who originated each of the prescriptions. With just this breakdown by objective on the pre-unit tests, the teachers were asked to generate a prescription for each of the twenty examples. In nineteen of the twenty cases, all of the teachers wrote exactly the same initial prescription

as the originating teacher's prescription. This endeavor, more than anything that we had written or said to the teachers, seemed to generate some understanding of what had been happening within the classroom.

From the discussions that were generated, the following conclusions were made:

1. The teacher, having only about two minutes a day to write each child's prescription, needed the necessary information updated regularly and easily accessible to her.

2. Many times the materials available provided no variety regardless of what the teacher would like to have assigned.

3. The terms mastery and self-direction need to be more specifically defined in relation to operating procedures and

4. Although prescriptions varied from child to child, the rationale behind this variation did not follow the child's learning needs.

As a result of these findings, a continuous program of teacher improvements was initiated beginning in the summer of 1966 and continuing to date. The measurable effects as a result of this are:

1. Prescriptions still vary when considered over an entire unit of study. (See Tables II through V)

2. The teacher who previously assigned nearly all the materials available to nearly all of the students needing work in a specific objective no longer follows this pattern but still assigns more work

than her fellow teachers. Table VII shows a comparison of this teacher, Teacher B, with other teachers assigning work in the same units. Whether or not this is a poor procedure will now be investigated in terms of retention and rate of progress of her students in later work dependent upon the skills learned with this procedure.

3. Efforts to provide the teachers with information relative to individual student behaviors so that they would not rely only on the pretests have not yet been successful.

4. Prescriptions now being written can be classified in the following categories:

    a. Students with pretest scores ranging from 90% to 100% for a given objective receive no work.

    b. Students obtaining pretest scores of 80% to 90% receive very little work and usually this is the first few pages of the materials plus the curriculum embedded tests.

    c. Students having pretest scores from 0% to 75% tend to receive prescriptions which can be characterized by:

        1. Initial prescription
        2. First additional practice materials and
        3. Second additional practice materials

In relation to this group of students falling into the 0% to 70% category we have not been able to find any relationship between the number of additional practice lessons needed or assigned and (1) pretest score, (2) I.Q., or (3) grade. However, the data in Tables VIII and IX seem to indicate that there is a relation here between teacher and amount of additional practice assigned.

In conclusion, under IPI it is possible to identify teacher practices and to generate the kinds of information necessary to report to the teacher so that she can modify her practices if need be.

TABLE I

Description of Behavior Objectives for Four Selected Units in the Mathematics Continuum

Level C - Addition

1. Use of associative principle.
2. Adds 2 numbers - sum of 20.
3. Sums 2 or 3 numbers, no carrying.
4. Uses $>$, $<$, $=$. Equations, 2-step, combining add-subtract.
5. Works column addition - 3 or more addends, sums to 20.

Level D - Subtraction

1. Mastery subtraction facts, numbers to 20.
2. Subtraction no borrowing - 3 or more digits.
3. Subtraction borrowing 10's place - 2 digits.
4. Subtraction borrowing 10's or 100's - 3 digits.
5. Subtraction borrowing 10's and 100's - 3 digits.

Level D - Multiplication

1. Groups sets to complete statements.
2. Repeated addition to solve multiplication problems.
3. Multiples using 0-1 as factors.
4. Oral-written multiplication factors 2, 3, 4, 5.
5. Fill-in frames - missing factors.
6. Completes 2 multiplication statements, illustrates commutative principle.
7. Uses terms, product, factors, labels.
8. Solves 1-step work problems, multiplication.

Level D - Division

1. Divides a set into subsets.
2. Multiplies facts to solve division problems.
3. Uses terms product, factor, quotient.
4. Divides problems thru $45 \div 5$.
5. Divides 2, 3, 4, 5 by 1 and into 0.
6. Fill-in frames, missing quotient.
7. Solves 1-step problems thru 5×10.

TABLE II

Percentage of Students Who Received the Same Prescription in the Unit of Addition at C Level by Objective

Objective	1965-66 No. of Students	1965-66 % of Agreement	1966-67 No. of Students	1966-67 % of Agreement
1	21	19	31	52
2	17	12	28	7
3	6	50	9	0
4	21	28	28	18
5	6	67	7	71
TOTAL	27	0.0	36	0.0

TABLE III

Percentage of Students Who Received the Same Prescription in the Unit of Subtraction at D Level by Objective

Objective	1965-66 No. of Students	1965-66 % of Agreement	1966-67 No. of Students	1966-67 % of Agreement
1	8	38	4	0
2	24	58	8	75
3	32	53	25	8
4	34	53	31	26
5	27	41	30	13
TOTAL	36	0.0	36	0.0

TABLE IV

Percentage of Students Who Received the Same Prescription in the Unit of Multiplication at D Level by Objective

Objective	1965-66 No. of Students	1965-66 % of Agreement	1966-67 No. of Students	1966-67 % of Agreement
1	10	40	4	0
2	4	0	5	0
3	17	53	13	70
4	17	65	12	58
5	13	38	13	69
6	15	80	16	44
7	25	60	27	63
8	17	35	14	21
TOTAL	27	0.0	33	0.0

TABLE V

Percentage of Students Who Received the Same Prescription in the Unit of Division at D Level by Objective

Objective	1965-66 No. of Students	1965-66 % of Agreement	1966-67 No. of Students	1966-67 % of Agreement
1	10	30	1	0
2	15	40	11	27
3	33	64	35	34
4	18	44	11	0
5	19	84	20	55
6	18	67	13	54
7	26	31	18	39
TOTAL	38	0.0	39	0.0

TABLE VI

Breakdown of Unit Pretest Scores for Selected Students Involved in IPI During School Year 1965-66

	Level	Unit	Skill	Pts	Pre	%
Student 1	C	Subtraction	1	10	5	50
			2	10	10	100
			3	10	9	90
		Total		30	24	
		%			80	
Student 2	C	Addition	1	10	5	50
			2	10	9	90
			3	10	10	100
			4	10	5	50
			5	10	10	100
		Total		50	39	
		%			78	
Student 3	C	Subtraction	1	10	3	30
			2	10	8	80
			3	10	10	100
		Total		30	21	
		%			70	
Student 4	C	Combination of Processes	1	10	10	100
			2	10	9	90
			3a	4	2	50
			3b	6	6	100
			4	10	4	40
		Total		40	31	
		%			78	

TABLE VII

Comparison of Average Pretest Scores and Average Number of Days to Reach Mastery by Teacher for School Years 1965-66 and 1966-67

Unit	Teacher	1965-66 Mean Pretest	1965-66 Mean Days	1966-67 Mean Pretest	1966-67 Mean Days
C-Add	G	62	22		
	A	78	31	68	13
	B	80	12	78	21
	C			71	12
D-Sub	A	60	27		
	B	49	28	57	20
	C	54	20	60	11
	D	83	19	52	14
	E			82	4
D-Mul	B	63	21	82	5
	C	63	15	75	6
	D	71	9	81	4
D-Div	B	70	15	75	10
	C	63	12	74	6
	D	75	8	78	6
	E	81	3	80	6

TABLE VIII

Comparison of Number of Students Receiving Initial, First Practice and Second Practice Materials for the Unit C-Addition in 1966-67

Unit	Skill	Initial	First Practice	Second Practice
C-Addition	1	29/31	9/31	6/31
	2	24/28	8/28	5/28
	3	6/9	0	0
	4	22/28	13/28	0
	5	5/7	0	0
	TOTAL	86/103	30/103	11/103

TABLE IX

Number of Students by Teacher Receiving Initial, First Practice and Second Practice Prescriptions for C-Addition in 1966-67

Skill	Total Number of Students	Initial A	Initial B	Initial C	First Practice A	First Practice B	First Practice C	Second Practice A	Second Practice B	Second Practice C
1	31	6	14	11	3	7	2	0	6	2
2	28	4	13	11	1	7	1	0	5	0
3	9	2	3	4	0	0	0	0	0	0
4	26	5	14	7	1	6	2	0	2	0
5	5	2	3	0	0	0	0	0	0	0

TABLE X

Percentage of Students Receiving First Practice and Second Practice Prescriptions by Teacher for C-Addition in 1966-67

Teacher	Number of Students	% First Practice	% Second Practice
A	19	26	0
B	47	42	28
C	33	15	6